BMP #52 - Oil/Water Separator

Targeted Pollutants

15% Sediment

5% Phosphorus

Trace metals

Bacteria

Petroleum hydrocarbons

Physical Limits

Drainage area 1 ac

Max slope 15%

Min bedrock depth 8 ft

Min water table 8 ft

SCS soil type ABC

Freeze/Thaw fair

Drainage/Flood control no

DESCRIPTION

Oil/water separators are multi-chambered devices designed to remove hydrocarbons from stormwater runoff as it moves through the device. Three variations are presented in this manual:

- Spill control (SC) separators are the least expensive and complex of the three. The device is a simple underground vault or manhole with a "T" outlet designed to trap small spills.
- American Petroleum Institute (API) separators are long vaults with baffles designed to remove sediment and hydrocarbon loadings from urban runoff. Large API separators may include sophisticated mechanical equipment for removing oil from the surface and settled solids from the bottom. Note: Many studies conducted on the east coast refer to this multi-chambered (generally three chambers) design with baffles as a "water quality inlet."
- Coalescing plate (CP) separators include a series of parallel inclined plates to encourage separation of materials of different densities. The plates are typically made of fiberglass or polypropylene and are closely spaced to improve the hydraulic conditions in the separator and promote oil removal.

APPLICATION AND LIMITATIONS

Oil/Water Separators have limited application in stormwater treatment because their treatment mechanisms are not well-suited to the characteristics of stormwater runoff (i.e., highly variable flow with high discharge rates, turbulent flow regime, low oil concentration, high suspended solids concentration). In addition, separators can require intensive maintenance, further restricting their desirability as a stormwater treatment BMP. The primary use of oil/water separators will be in cases where oil spills are a concern. Their inclusion in these guidelines is merely to provide as wide a range as possible of stormwater BMPs. While the use of oil/water separators may be appropriate for high traffic areas such as multi-family dwellings and apartment complexes, the decision to use an oil/ water separator should be made on a case-by-case basis.

If an oil/water separator is to be used for treatment it should be located off-line from the primary conveyance/detention system. The contributing drainage area should be completely impervious and as small as necessary to contain the sources of oil. Under no circumstances should any portion of the contributing drainage area contain disturbed pervious areas which can be sources of sediment.

Design Parameters

The following design parameters apply to all three separator types:

1. Separators should precede all other stormwater treatment.

2. Appropriate removal covers must be provided that allow access for observation and maintenance.
3. Stormwater from building rooftops and other impervious surfaces are not likely to be contaminated by oil and should not be discharged to the separator.
4. Any pump mechanism should be installed downstream of the separator to prevent oil emulsification.

Additional requirements for API and CPS-separators:

1. Separators should be sized for the water quality design storm (1/3 of 2-year event, see Appendix D). Larger storms should not be allowed to enter the separator; the use of an isolation/diversion structure is recommended.
2. Separators should have a forebay to collect floatables and the larger settleable solids. It's surface area should not be less than 20 square feet ($1.8m^2$) per 10,000 square feet ($930m^2$) of the area draining to the separator.

Additional requirements for CPS-separators:

1. Plates should not be less than 3/4 inch (18 mm) apart.
2. The angle of the plates should be from 45 to 60 degrees from the horizontal.

Absorbent pillows may be used in separators. For API and CPS-type separators they should be placed in an afterbay. With the SC-separator, absorbent materials should be placed in the manhole/vault. Used absorbent pillows will need to be properly disposed of.

Sizing Procedure

Oil droplets exist in water in a wide distribution of sizes. The separator therefore is sized to remove all droplets of particular size and greater which will ensure that sufficient oil is removed to achieve the effluent standard.

API-separators are usually sized to remove oil droplets 150 micron in size and larger. Smaller droplets rise so slowly as to require a relatively large vault. CPS-separators are commonly sized to remove 60 or 90 micron and larger oil droplets.

There are no data on the size distribution of dispersed oil in stormwater from commercial or industrial land uses with the exception of petroleum projects storage terminals. These data indicate that by volume, about 80 percent of the droplets are greater than 90 micron. Less than 30 percent are greater than 150 microns. For these guidelines, both the API and CPS-separator are sized to remove 60 microns and larger droplets at a temperature of 10 degrees C giving a rise rate of 0.033 feet per minute (10 mm). The requirement for treatment of 60 micron and larger sized droplets may preclude the use of API separators.

API-Separator Sizing

API-separators are sized using these general guidelines.

- Horizontal velocity: 3 ft./min (1m/min) or 15 times the rise rate whichever is smaller (rise rate of 0.033 ft/min (10mm/min) is recommended
- Depth of 3 to 8 feet (1 to 2.4 m)
- Depth to width ratio of 0.3 to 0.5
- Width of 6 to 16 feet (1.8 to 4.9 m)
- Baffle height to depth ratios of 0.85 for top baffles and 0.15 for bottom baffles

The separator is first sized for depth using the equation:

Depth = (Q/2Vh).5

where,

Q = design flow (cfm)

Vh = design horizontal velocity ft/min = 0.50 (15 times 0.033)

Calculate the width using the above ratios (i.e., 0.3 to 0.5 depth-to-width ratio).

Then calculate length using the equation:

Length = depth/rise rate * Vh = [(Q/2Vh).5/0.033] * 0.50

CPS-Separator Sizing:

Calculate the projected (horizontal) surface area of plates required using the following equation:

Ap = Q/rise rate

where,

Ap = projected surface area of the plate (ft2); note that the actual surface area, As = Ap *

cosine(H)

H = angle of the plates with the horizontal in degrees, usually varies from 45-60 degrees

Q = design flow (cfm)

Rise rate = recommend using 0.033 ft/min

Manufacturers of plate packs provide standard size packages which are rated at a particular flow (usually gpm). However, as the manufacturer's flow rating is for conditions different than used above, the engineer must compare the plate surface area with the above calculation. Do not confuse projected plate area with actual plate area.

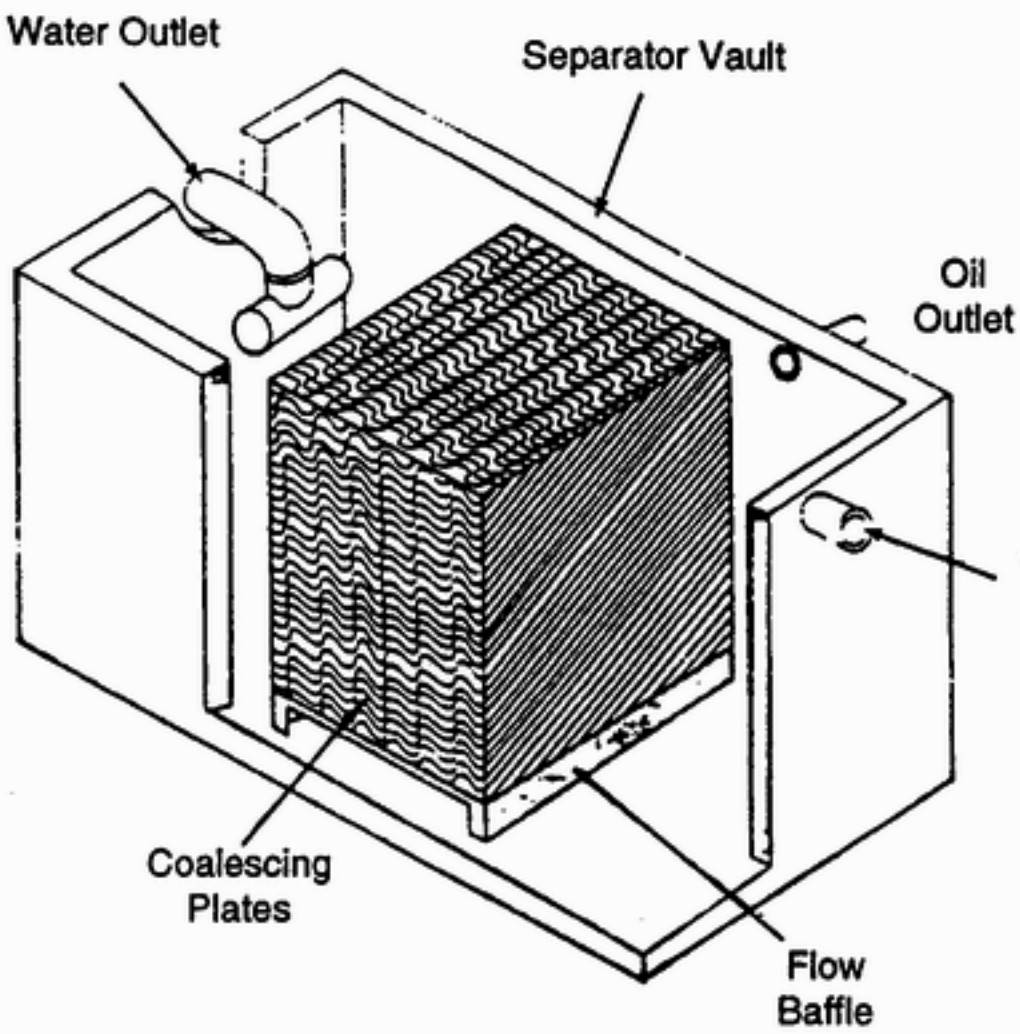
The width, depth, and length of the plate pack and the chamber in which the plate pack is placed is completely flexible and is a function of the plate sizes provided by the particular pack manufacturer and standard size vaults that are available for small sites.

Refer to the King County Surface Water Management Manual for additional design and sizing details.

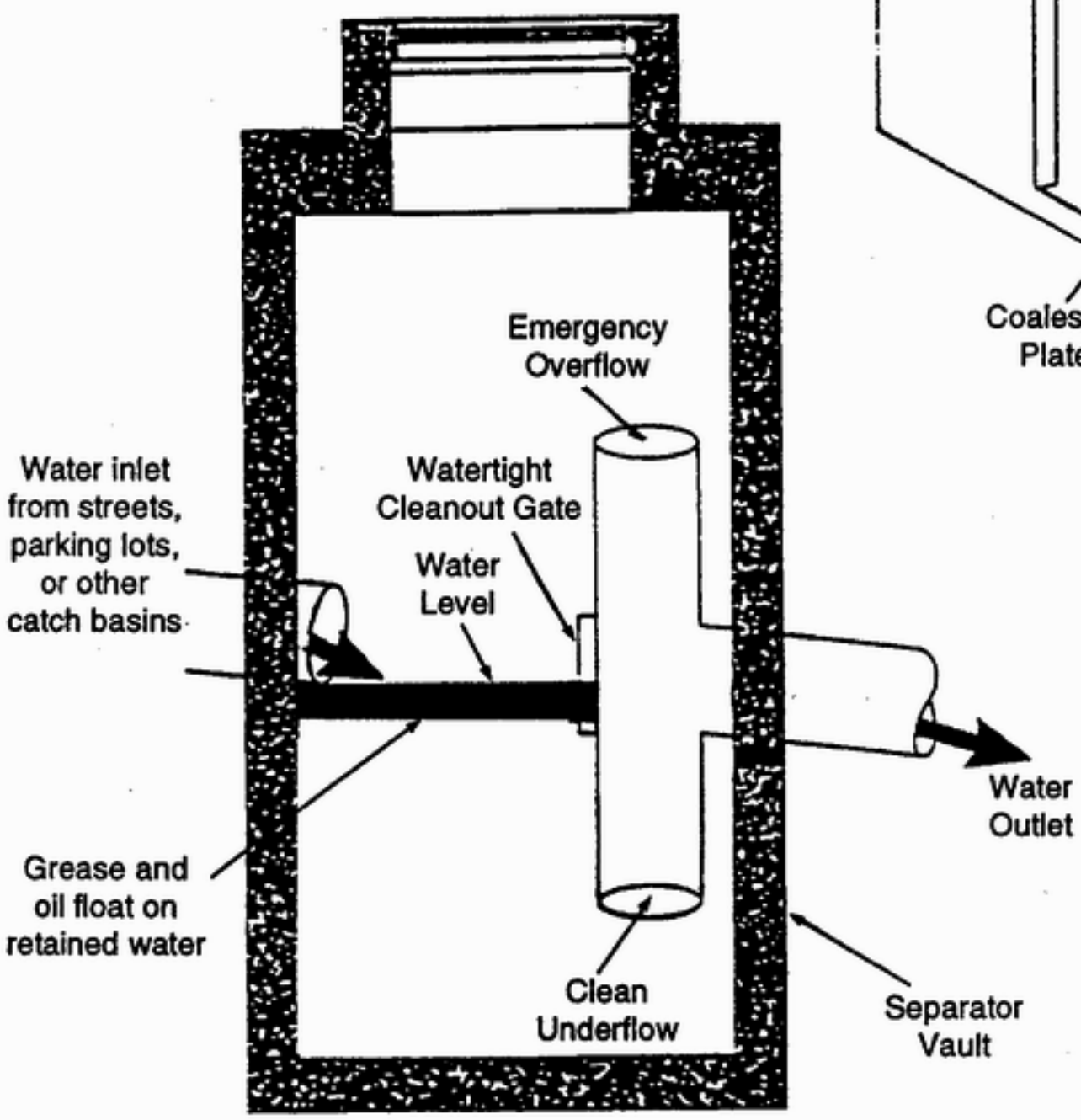
Maintenance

Oil/water separators must be cleaned frequently to keep accumulated oil from escaping during storms. As a rule of thumb, they should always be cleaned by mid-October to remove material that has accumulated during the dry season, and again after a significant storm. In addition:

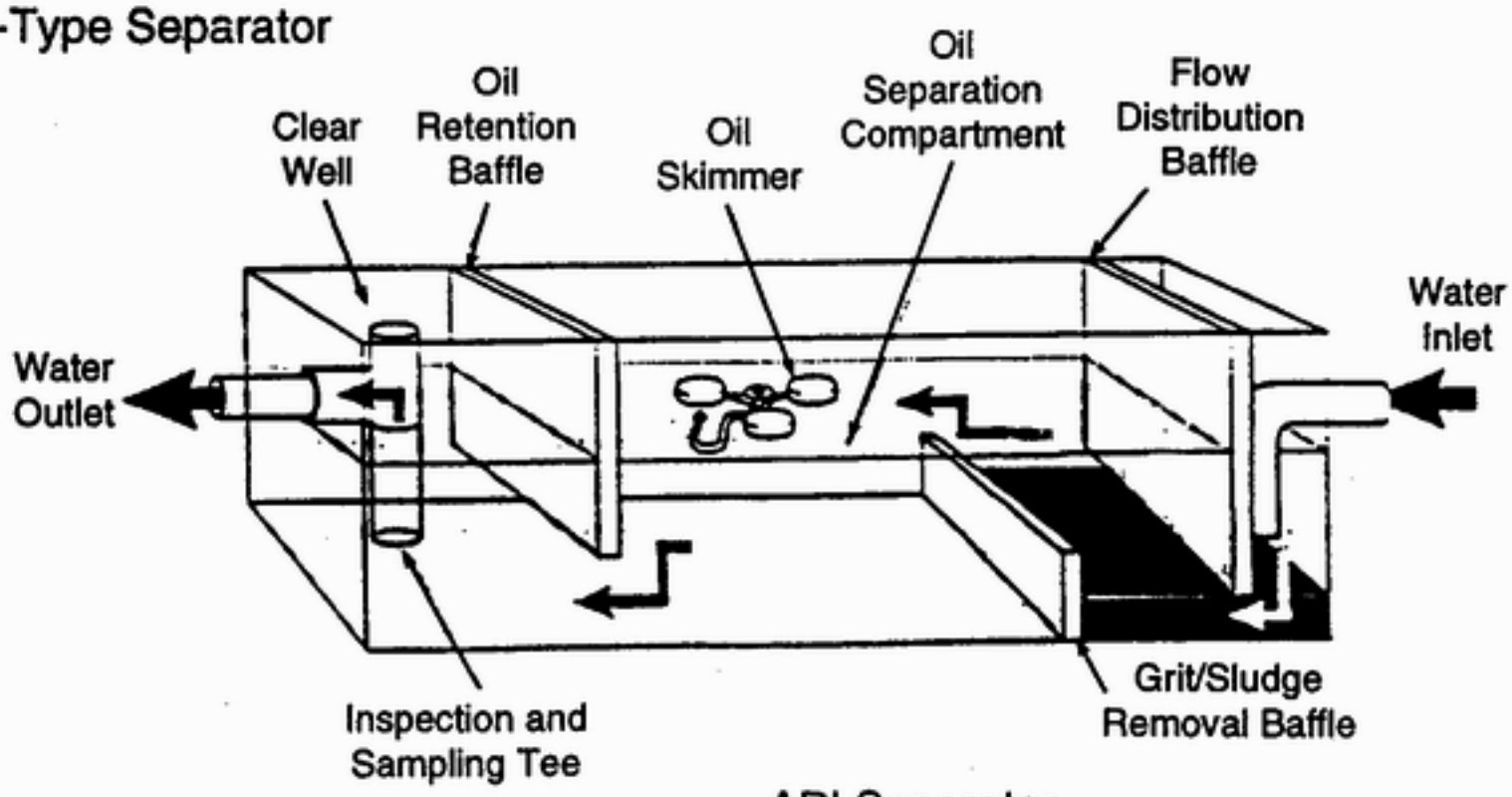
1. The facility should be inspected weekly by the owner.
2. Oil absorbent pads are to be replaced as needed but should always be replaced in the fall prior to the wet season and in the spring.
3. The effluent shutoff valve is to be closed during cleaning operations.
4. Waste oil and residuals should be disposed in accordance with current local government health department requirements.
5. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at a discharge location approved by the local government.
6. Any standing water removed should be replaced with clean water to prevent oil carry-over through the outlet weir or orifice



CPS Separator



SC-Type Separator



API Separator